DEFENCE R&D DÉFENSE

1997 Canadian Forces Air Operations Vision Survey

Section VIII, IX, X and XI
Medical Support Issues

M.F. Heikens
H.J. O'Neill
G.W. Gray
D.A. Salisbury

DEFENCE AND CIVIL INSTITUTE OF ENVIRONMENTAL MEDICINE

Technical Report
DCIEM TR 1999-080
August 1999

National Defence Défense nationale

Canada

AUGUST 1999

DCIEM TR 1999-080

1997 CANADIAN FORCES AIR OPERATIONS VISION SURVEY SECTION VIII, IX, X AND XI MEDICAL SUPPORT ISSUES

M.F. Heikens
H.J. O'Neill
G.W. Gray
D.A. Salisbury

Defence and Civil Institute of Environmental Medicine
1133 Sheppard Avenue West, P.O. Box 2000
Toronto, Ontario
Canada M3M 3B9

DEPARTMENT OF NATIONAL DEFENCE – CANADA

EXECUTIVE SUMMARY

In 1997 DCIEM conducted an Air Operation Vision Survey to gather information from CF pilots on medically related vision issues. This second report outlines issues related to the visual standard for pilot applicants, clinical support at the Base/Wing level and operational performance of spectacles and contact lenses prescribed by CF medical and associated civilian personnel.

For pilot candidates of otherwise equal suitability, the majority of pilots surveyed favoured using 20/20 uncorrected vision as a selection standard. The response was influenced by current position as staff officers or line pilots and by use of corrective lenses. Pilots considered normal colour vision as an important selection factor regardless of their own colour vision status. Approval of visual surgery as a means to improve visual acuity was not favored by the pilot population surveyed.

Support at CF Base/Wing level was generally rated as "acceptable" and was not influenced by the pilot's current position, location, age or corrective lenses use. However, the understanding of the specific needs for pilots by the military medical personnel was rated as "borderline". The reluctance to discuss visual matters with medical personnel was influenced by age and previous grounding related to visual matters.

Of the population who answered the survey twenty-nine percent were wearing corrective lenses (spectacles and/or contact lenses). Six percent of the corrected population were wearing multifocals which were seldom set for their particular cockpit/flightdeck. Tactical and fighter pilots considered their unrestricted and uninterrupted field of view too narrow and although double segment multifocals were judged useful, only ten percent of the pilots were wearing them. On average the spectacles offered by the CF were judged as "acceptable" and received within one month of their request. Forty-one percent of the pilots wearing spectacles reported perceptual problems with a new pair of spectacles and indicated distortion as the main problem. Five percent of the pilots wearing spectacles reported having been injured by their spectacles mainly along the nose bridge. Pilots preferred soft contact lenses; drying out and dust/lashes under the lenses were reported as the main inconveniences.

The clinical medical support offered to pilots is an important aspect of a pilot's career. Trust in medical personnel, understanding the basis for visual examinations, and availability of accurate and current information on operational visual matters are key elements of the medical support system. Further, once a pilot is wearing spectacles or contact lenses for flying duties the equipment prescribed should be safe, provide the best possible vision and be properly fitted to minimize discomfort and optimize performance

This survey has proven useful in identifying shortcomings in the clinical and medical administrative support offered to CF pilots in the provision of ophthalmologic and optometric services. The survey has further demonstrated the need for medical personnel to have a better understanding of operational visual requirements and limitations related to both the equipment and the operational conditions.

ABSTRACT

Introduction: In 1997, DCIEM conducted an Operational Vision Survey of current Canadian Forces pilots. This second report deals specifically with the clinical and administrative support offered at the Base/Wing level and the use of spectacles and contact lenses. **Results:** 1551 questionnaires were sent out. 813 questionnaires were completed and 200 returned "undelivered" for a response rate of 61% of those actually received. On the administrative and clinical support questions, the majority of pilots favoured the selection of candidates with uncorrected visual acuity of 20/20 or better and judged colour vision as an important selection criteria. 46% of the pilots indicated interest in improving their visual acuity through the use of spectacles and 28% indicated they would consider eye surgery including Photorefractive Keractectomy (PRK). When pilots were asked to consider potential adverse effects of surgery on visual acuity, contrast and glare sensitivity, the number contemplating surgical correction dropped significantly. 86% were receptive to yearly complete visual examination. Staff officers and operational pilots wearing spectacles were more likely than uncorrected individuals to accept yearly visual testing. On average the clinical support offered at the base level was judged as "acceptable" but the understanding of the specific visual requirements for pilots by the medical professionals was considered as "borderline". Pilots were more likely to discuss openly visual matters with civilian than military professionals and their reluctance level increased when they had been previously grounded for ocular problems. 29% of the surveyed pilot population were wearing either spectacles and/or contact lenses. 6% of the group requiring visual correction were wearing multifocals but these were seldom correctly prescribed for their current cockpit environment. Tactical and fighter pilots considered that their multifocals did not have large enough unrestricted and uninterrupted field of view. The majority of these pilots also considered double segment multifocals useful but only 10% of them were wearing them . On average the spectacles offered by the CF were judged as "acceptable" and received within one month of their request. 41% of the pilots reported perceptual problems with a new pair of spectacles. The most common problem encountered was one of distortion. 5% of the pilots wearing spectacles reported injury from spectacle use, mainly along the nasal bridge. CF pilots prefer soft contact lenses (SCL). The main problems reported with SCL was drying out and dust/lashes under the lenses. **Conclusions:** Medical personnel should develop a better understanding of operational visual requirements, life support equipment and cockpit configuration to improve their clinical and administrative support to pilots. Personnel working closely with pilots or prescribing visual aids should be provided with up to date information regarding operational visual requirements. In turn, they must provide pilots with useful and pertinent information on the potential impact of decreased visual function on their task capabilities.

TABLE OF CONTENTS

INDEX OF TABLES

INDEX OF APPENDICES

INTRODUCTION

Visual acquisition of information continues to be of paramount importance to the aircraft pilot. Increasingly sophisticated visual aids have increased rather than decreased visual demands. Standards are sometimes misunderstood by aircrew (and medical personnel) even though they may have a significant career impact. Commercial advertisements encourage pilots to have corrective visual surgery without addressing the visual demands of the aviation environment. Medical support systems must gain pilot trust to be effective. This requires a thorough knowledge of the visual requirements in operational environments and a willingness to explain the basis and need for recurring visual examinations. Once spectacles and/or contact lenses are prescribed for flying duties they must be safe, properly fitted and provide the best possible vision with minimum discomfort.

The 1997 CF Air Operation Vision Survey was sent out to obtain the opinion of pilots on several medical support issues. These included visual standards for pilot selection, clinical support and the performance of spectacles and contact lenses in their opeational environment. The survey also sought to evaluate the operational relevance of current medical services in providing for the specific needs for the pilot population.

The results derived from the questions related to medical support issues are reported here. Sections in the questionnaire related to CF visual standards and clinical support addressed the following topics:

- visual selection criteria including the importance of colour vision;
- likelihood of selecting spectacles and/or visual surgery to improve visual acuity;
- perceived level of acceptability of yearly complete visual examinations;
- rating of clinical support offered by various military and civilian medical personnel on and off base;
- likelihood of discussing visual matters with military medical personnel; and,
- grounding related to visual matters.

The sections pertaining to Spectacles and Contact Lenses were aimed at:

- defining the profile of those wearing single or multifocal spectacles and contact lenses; and,
- gathering general and operational information regarding the use and performance of spectacles and contact lenses in air operations.

METHODS

In May 1997, 1551 questionnaires were sent to all regular and reserve CF pilots listed within National Defence Headquarters (NDHQ) as of April 1997. Accompanying the survey were letters from the Commander of Air Command and the Director of Flight Safety recognising the importance of this exercise and encouraging pilots to provide answers reflecting their personal experience. Nine operational roles were canvassed; Tactical Helicopter (TH), Search & Rescue Rotary Wing (S&RRW), Maritime Patrol Rotary Wing (MPRW), Maritime Patrol Fixed Wing (MPFW), Transport (TSPT), Fighter (FGT), Jet Trainer (JTR), Primary Trainer Fixed Wing (PTFW) and Primary Trainer Rotary Wing (PTRW). Four months were allocated for survey returns to DCIEM.

Questions pertaining to visual standards, clinical support, spectacles and contact lenses were of three types: yes/no answers, a choice of answers with the possibility of a written comment, and rated answers. Rating was achieved through one of 2 different 5-point scales and for all questions requiring a rating, an example of the scale to use was presented above the question or at the beginning of a sequence of questions using the same scale.

Scale	Rating value				
	1	2	3	4	5
Acceptability	wholly unacceptable	unacceptable	Borderline	acceptable	wholly acceptable
Importance	very unimportant	unimportant	Borderline	important	very important

STATISTICAL ANALYSIS

Data were analysed through non parametric statistical tests:

- Mann-Witney U (MWU) (equivalent of a parametric t-test) tests the hypothesis that the distribution underlying two groups is the same. The MWU was used to assess the effect of two-level demographic variables such as position, correction, wear of spectacles or contact lenses or work place.

- Kruskal-Wallis (KW), equivalent to a one-way ANOVA, tests the hypothesis that the distribution underlying three or more groups is the same. The KW was used to evaluate the effect of multi-level demographics variables such as operational role, specific work place or age group.

- Friedman Ranking (FR), equivalent to a 2-way ANOVA, tests the hypothesis that the response to a condition is the same against the hypothesis that at least one condition produces a different outcome. The FR was used to rank the acceptability level of the support offered by various type of medical personnel or at the squadron or headquarters level as well as ranking preferred characteristics for spectacles, the acceptability level of training, or information about multifocals or contact lenses.

- Contingency Tables (CT), to determine if a relationship existed between two nominal variables. The CT determine if yes/no questions or questions with multiple choice of answers were influenced by factors including operational role, visual correction, spectacles or contact lenses use and work place or age group.

RESULTS

A. DEMOGRAPHICS

By October 1997, 813 questionnaires were completed and returned to DCIEM from the initial 1551 sent out. Sixty-four (64) questionnaires were returned stating "released from the CF" and 136 with stated "posted", "unknown", or "no return address". The final return rate for this voluntary CF survey, was 56%. However, if we account strictly for those who actually received the survey the return rate was 60%.

The percentage of pilots answering the section on spectacles (spectacle wearers) was 28% while that for contact lenses was 6%. Percentage of respondents for the sections on visual standard and clinical support varied from 64% to 98% depending on the question.

B. VISUAL STANDARDS AND CLINICAL SUPPORT

a. Pilot opinions about visual standards

(1) Selection criteria based on visual acuity (VA)

73% of the total surveyed population agreed that for equally suitable pilot applicants, the uncorrected visual acuity standard should be 20/20 or better. (61% of pilots requiring corrective lenses and 77% of the uncorrected population agreed with this standard). Again, there was a significant relationship between the response and the wearing of corrective lenses. (Fisher exact p-value <0.0001). Individuals wearing correctives lenses continue to favour like individuals.

There was a tendency for staff officers to select individuals with uncorrected VA of 20/20 compared to current operational pilots (Fisher exact p-value 0.074). Operational role or age group were not factors influencing the decision.

Comments/Discussion: The fact that the majority of pilots including those wearing corrective lenses were in agreement with using 20/20 uncorrected visual acuity as a selection standard provides support from the operational side for current selection visual standards. As expected the choice of a selection criteria was influenced by the use of corrective lenses.

(2) Colour vision

Colour vision was judged "important" or "very important" by 92% of the pilots who answered the survey. Only 11 pilots (roughly 2%) out of the 577 who provided us with their colour vision (CV) category said they

were classified as CV2. These pilots would have passed the Ishihara plates and failed the lantern test. Of these 11 CV2 pilots, three considered colour vision as "unimportant", three as "borderline" and five as "important". Two of these pilots were not on flying status and one omitted to provide us with information. Of these CV2 pilots only 1 was employed in a fully coloured coded aircraft e.g. the Challenger (and one was working on the Hercules soon to be converted into a glass cockpit). Table 3 presents the rating of the importance accorded to colour vision.

Comments/Discussion: While in the past colour vision was important to discriminate red, green and white lights outside the cockpit, colour coding used in new generation aircraft such as the Airbus the Challenger and soon the Hercules, is much wider and requires highly discriminative colour vision in order to safely interpret colour-coded information. The increasing use of coloured visual protectors such as the laser protective device, and smoke goggles in FWMC (Fixed Wing Muli-Crew) aircraft may cause increased colour confusion in the modern "glass" cockpit (Ivan et al, 1999 and Yung et al. 1999). A current example is the use of Blue Blockers-like smoke masks in use on CF aircraft. Blue Blockers (BB) have been shown to cause problems in colour discrimination (Thomas & Kuyuk, 1988 and Kuyuk & Thomas, 1990). Colour confusion has been reported between blue and purple, blue-green and green, blue-green and blue and yellow and orange. This colour confusion is more pronounced for small targets and does not seem to resolve as the illumination rises. Symbology of CRT displays is considered small-target and is prone to such effects. It has been demonstrated that BB may cause serious blue-yellow colour confusion for both CV1 (colour vision category 1 – normal colour vision) and CV2 (colour vision category 2 – colour vision safe) individuals (Heikens, 1997). Since CF aircraft such as the Challenger and soon the Hercules, are likely to use BB type visors in an emergency situation involving smoke in the cockpit it is important to recognize that pilot effectiveness in the reading and the interpretation of instruments will be seriously degraded and that the effectiveness of CV2 pilots will be further reduced. The fact that both CV1 and CV2 pilots reflected the importance of colour vision in this survey supports the stringent colour vision standards for selection.

b. Who should determine vision standards?

Of the pilots who responded, 87 % preferred to see visual standards set by a working group including both the operational and medical communities. Only 2% were willing to see the standards set by the medical community alone while 11% thought that operators were best suited to set CF aircrew visual standards. Table 5 shows the frequency distribution of those considered best suited to set CF visual standards by the overall pilot population and by operator and staff officers.

Comments/Discussion:. It was clear from the answers received in this survey that operational pilots do not feel that medical personnel have sufficient insight to decide on these standards alone. The vast majority of pilots surveyed favour a joint operational/medical approach to developing vision standards.

c. How often should pilots have eye examinations?

The majority of pilots favoured yearly visual exams (62%). Pilots currently requiring vision correction, and older pilots (age 40-55) were more likely to favour yearly testing than younger pilots, as were staff officers when compared with those on current active flying status.

284 pilots provided written comments regarding why yearly complete visual examinations should not be mandatory. These comments were grouped under three headings; frequency of examinations, testing rational, fear of grounding.

58% of comments related to frequency of examinations. Suggested frequencies ranged from 2 to 5 years. Some pilots emphasized more frequent testing after age 40. 36% of comments related to the the rationale for and adequacy/inadequacy of current testing, benefits and cost/benefit comments, and concerns about cycloplegic refraction. Many commented that visual problems would be detected on the yearly aircrew medical without the requirement for specialist eye examination, and that a pilot encountering visual problems would themselves request a specialist eye consultation. An exhaustive list of comments is presented at Appendix A Table 1.

Comments/Discussion: Similar to the civilian population, a large proportion of CF pilots favour yearly visual testing going beyond simple VA assessment (Asmus et al. 1997). This likely reflects the clear recognition by pilots of the importance of vision in the operational environment, and the desire to maintain a high standard of vision. However, this was not universal, and individual suggestions support less frequent examinations, and adjusting the frequency of examinations with age.

d. Clinical Support Issues

Overall, clinical support was generally rated as "acceptable" whether in Canada or abroad. There was no difference in rating associated with location, position, operational role, or requirement for corrective lenses.

For the 97% of pilots who recalled who did their last eye examination, the majority (63%) were performed by military medical personnel. 82% of these eye examinations were done by a Physician's Assistant or an Ophthalmic Technician, while 35% had their last eye exam performed by civilian eye specialists. Testing done by military ophthalmologists accounted for only 7% of all examinations and 12% of all military examinations.

72% of respondents indicated they had been able to see an ophthalmologist within 1 month of their request. The average waiting period was between 2-4 weeks, and was similar for all ranks. Employment at squadron level or headquarters did not predict the wait before seeing an ophthalmologist. Table 6 presents the frequency counts of each type of examiner, military or civilian and generalist or specialist personnel.

Acceptability of examiners regarding the understanding of the specific visual needs of pilots was ranked on average as "borderline". There were no statistical differences in the mean rating associated with the various eye examiners. There were, however, significant differences in the level of satisfaction between civilian /military (MWU p-value 0.004) and generalists/ specialists (MWU p-value 0.03). Civilians and specialists were preferred over military and generalists.

There was no difference in rating associated with location, position, operational role, or the use of corrective lenses. Only age groups showed a significant difference, the level of acceptability raising with age (KW p-value 0.03).

. The majority (83%) of pilots indicated a willingness to discuss visual problems with their Flight Surgeon, whether or not they wore corrective lenses. Younger pilots (under 40) and those previously grounded because of a vision problem indicated more reluctance to discuss visual problems. 120 of the 130 respondents who indicated a reluctance to discuss visual problems provided reasons regarding their reluctance. These were regrouped under 3 categories; fear, mistrust and previous wrong decisions. 99 of the 120 indicated fear of job loss as the main reason, 17 as mistrust of medical personnel, and 4 as previous mis-diagnosis. An exhaustive list of their comments is presented at Appendix A Table 2

Of the 39 pilots who had been previously grounded due to vision related problems 34 provided reasons for their grounding. These reasons could be regrouped under 5 categories: eye diseases and injury; visual problems subsequent to other medical problems; wrong diagnosis, spectacles related problems, and operational hazards. Annex A Table 3 presents the exhaustive list of these grounding reasons.

Comments/Discussion:

Although the clinical support at Air Base level was judged "acceptable" the understanding of medical personnel regarding the specific visual requirements of pilots was judged as "borderline". It was somewhat surprising that military medical personnel were ranked lower than their civilian counterparts in their understanding of aircrew vision issues. This result agrees with the finding that pilots regard military medical staff as more stringent than civilian personnel and thus prefer to discuss visual problems with civilian practioners. This reluctance to discuss visual problems with military medical personnel and the lack of trust within the working environment has already been reported in other pilot surveys (Backman and Smith, 1975 and Asmus et al 1997).

From the written comments provided with the survey, there are clearly some concerns about the clinical examinations including the impact of and need for repeated cycloplegic examinations. In addition, pilots express a desire for more information on vision issues such as the potential adverse impacts of environmental/operational conditions on long term visual well-being, and information on the function of spectacles (mainly multifocals) in their cockpit environment. Pilots also mentioned that medical personnel provide them with little or no information regarding the visual requirements for or limitations with NVG (Night Vision Goggle) flying, laser equipment or performance of their spectacles.

Feedback from the questionnaire thus highlights areas in which provision of clinical visual services by the CF can be improved. The CF no longer employs uniformed ophthalmologists. Thus, it is most important that Flight

Surgeons, Physicians Assistants, Ophthalmic Technicians and others providing clinical services related to vision be appropriately trained and prepared to answer concerns/questions with respect to these issues. It is also important to stress that the object of aircrew vision assessment is to enhance flight safety and mission accomplishment, and that vision assessments are not a punitive measure by the medical community on the aircrew population. Pilots express a significant willingness to discuss vision issues with their Flight Surgeon, and it is important to keep Flight Surgeons informed of current issues with respect to aircrew vision.

C. SPECTACLES AND CONTACT LENSES

a. Profile of the population wearing spectacles and contact lenses (CL)

29% of the respondents indicated current use of visual aids for flying duties whether spectacles, CL or both. Spectacles were worn by 79% , spectacles/CL by 8% and CL only by 13%. A large majority of CL wearers (72%) also wore spectacles. Myopia accounted for 55%, hyperopia for 19% and those requiring correction for both near and far vision accounted for 26%. Percentages of corrected individuals in the Regular and Reserve forces were respectively 28% and 45%. The use of contact lenses was more common in fixed wing single crew ops, and spectacles in fixed wing multiple crew ops. Age was not predictive of spectacle vs CL use.

Of those wearing contact lenses, soft CL were worn by 78% of the pilots, disposable CL's by 16% and rigid or semi-rigid CL's by 8 %. Rigid or semi-rigid CL were exclusively worn by TH pilots. Spherical lenses accounted for 60%, toric on both eyes for 16% and a mix of spheric/toric for 4%. The remaining 20% did not know the type of CL were worn. Tinted CL were worn by three pilots. These CL were qualified as mauve and were worn by all three pilots at the office , in flight and at home. Two of them stated that they had only this type of CL.

The operational role with the highest representation of pilots wearing spectacles was the MPFW with 45%, the lowest in S&RRW with 13%. Operational roles with the highest proportion of CL wearers were FGT (15%) and PTRW (17%), the lowest TH, MPFW and TSPT all with 5%. Table 8 presents the distribution of those wearing spectacles and contact lenses by age group, operational role and airframe type.

Comments/Discussion: The percentage of Regular force pilots using visual correction aids in this survey at 28% is similar to the data from the US Army medical database with 22%. The CF Reserve has a higher percentage of pilots wearing visual correction than their US Army counterparts - 45% against 32% (Schrimsher and Lattimore, 1991). The fact that almost a third of Regular force pilots and close to half of Reserve pilots require corrective lenses highlights the importance of vision issues - from selection standards through to the provision of best clinical services for vision correction.

b. Spectacles – clinical and operational issues

(1) General considerations

On average, choice and quality of frame, quality of lenses, and delivery time were rated as "borderline" while fitting was rated as "acceptable". The rating was not influenced by the type of visual aids whether single or multifocals. Spectacles were received on average within one month but the majority were received within 2 weeks (59%).

64% percent of pilots said that they routinely assessed a new pair of spectacles for distortion, colour perception and visual performance prior to the first flight but 36% admitted not doing it. 41% of the pilots wearing single focal spectacles reported problems against 44% for those wearing multifocals. Most commonly encountered problems were distortion (64%) followed by false distance perception (46%) and headaches (44%). There were no statistical differences between the frequency of problems and the type of lenses worn whether single focus or multifocals.

32% of the pilots indicated they had received spectacles with tinted lenses; 39% qualified them as neutral grey, 21% as light brown , 5% as green, 4% as light purple, and 2% as amber while 39% did not provide the colour. All pilots who reported problems related to colour perception had received tinted spectacles. All but one individual had received what they qualified as "neutral gray" tinted lenses. 42% of those who reported problems with their spectacles had requested a new pair, 21% went back to their old pair and 12% kept on wearing them. Table 10 presents an overview of the frequency counts in percentage of problems encountered and the course of action taken after noticing the problem(s).

The majority of pilots (80%) reported changing their spectacles after two years or more. The main reason for changing spectacles was scratches on lenses (61%). Table 11 presents an overview of the rate and reasons for changing spectacles.

Most pilots wear mainly CF rather than civilian frames (81% vs 19%). All features were rated as "borderline". A Friedman ranking of these features showed that the choice of frame was the feature with which the pilots were the least satisfied (p-value <0.0001).

(2) Operational considerations

10 pilots reported having been injured by their spectacles in flight; 7 of them were wearing CF frames and only one a civilian frame. Areas injured were; along the nasal bridge (4), side of the nose (1), inside corner of the eye(s) (2), nasal bridge and cheeks (2), and nasal bridge and inside corner of the eye(s) (1).

All potential problems associated with spectacle- wearing were judged as "important" except allerginicity of the frames. Most important problems in the FWMC and the RW (Rotary Wing) environment were the pressure points around ears and reflection/glare problems. The most important problem identified in the FWSC (fixed wing single crew) environment was pressure points around the nose. Compatibility with NVG was rated as "borderline" by rotary wing pilots. Friedman ranking for the potential problems of frames in flight in FWMC, FWSC and RW are presented at Table 12.

(3) Bifocal and multifocal spectacles

Multifocals were worn by 6% of the corrected population . 90% of these lenses were bifocals. Pilots wearing bifocals were encountered in all operational roles while those wearing tri-focals were encountered in TH, MPFW, TSPT and FGT groups. 70% of pilots wearing multifocals said they had a large enough uninterrupted field of view . 29% of the pilots wearing multi-focals said that their unrestricted field of view was not large enough, particularly in FGT (68%) and TH (76%). Of the 30% who indicated otherwise, 40% were TH and 31% FGT. 53% said that double segments would be beneficial but only 10% were wearing them at the time. TH and FGT groups were the operational roles where double segment multifocals were deemed most likely to be beneficial in a proportion of 70% and 64% respectively. 48% of the pilots indicated that their multifocals had never been set for their cockpit. 17% did not know whether or not their multifocals lenses were cockpit oriented, and 28% indicated their prescription was determined by cockpit requirements

52% of the bifocals were straight top, 27% executive and 22% progressive. 75% of trifocals were executive style while straight top and progressive accounted each for 13%. Only 59% of the pilots indicated they were able to obtain their preferred multifocals (54% had requested progressive multifocals). The executive style was easily accessible (90%) while the progressive was more difficult to obtain (41%). 13% of those wearing multifocals for flying wore a different pair for desk work. Table 13 presents the frequency distribution of visual aids and the characteristics of the spectacles, multifocal and CL worn by the pilots.

Comments/Discussion: The survey indicated a lack of standardised approach to the prescription of spectacles for CF pilots. The type of safety frame, lens colour and type, design of nose clip and height of multifocals are all examples of problem areas. Despite years of efforts in this area it was disappointing to note the continued dissatisfaction on the part of the pilot community in regard to these fundamental problems. A review of the opinions expressed suggest that pilots require more information on the problems of new spectacles. Concerns such as distortion, headaches, and false distance perception should be briefed at each new and repeat prescription. To this end appendix B1 and B2 are useful guidelines.

The need to prescribe appropriately spectacles for pilots needs re-emphasizing. Although prescribing spectacles for myopia may be straight forward, visual correction for the presbyopic pilot is a more complex and difficult task. A significant consideration in prescribing multifocals to pilots is related to the testing distance (Miller et al, 1989). Currently, standard clinical near visual testing generally varies between 12-14 inches depending on the test used but these distances are far from the 26 to 28 inches of most instrument panels. Although assessing vision at

12-14 inches is helpful in determining a requirement for correction for desk work it does not assess the visual performance at distances representative of the operational cockpit environment.

Based on the survey data, multifocals are often not prescribed for cockpit distances. Forty eight percent of the pilots said that their multifocals were not set for their cockpit distances and 27% did not know whether or not this had been done. Clinically, multifocals are generally prescribed for distances between 12-14 inches, far from those encountered in the modern cockpit environment. Backman and Smith (1975) published a guideline for the prescription of multifocals for civil pilots and Miller et al. (1989) did similar work for the USAF and included in their article extensive measurements of console/pedestal distances and print. Special attention should be paid to pilots requiring multifocals, and to the particular aircraft in which they will be flying with their spectacles. Lenses prescribed should be appropriately fitted to the cockpit environment and position of each pilot following the guidelines provided by the USAF.

c. Contact Lenses (CL)

Contact lenses were rated as either "acceptable" or "wholly acceptable" by all pilots surveyed. A Friedman ranking analysis did not demonstrate the importance of one compatibility criteria over others. Table 14 presents the FR analysis results.

Of 46 pilots reporting problems using CL during flight duties, three (6%) reported having a lens pop out during flight, 24 (50%) reported problems with dryness, and 15 (33%) problems with dust/lashes under the lens. 33% of pilots reported problems with contact lenses on extended flights (dryness, shifting). Ten percent of the respondents with SCL (soft contact lens) experience in exposure to G forces reported lens shifting. Three pilots reported they had been unable to fly due to CL related problems including dried and infected eyes. . Problems with dust and lashes were mostly encountered in the RW environment crews (43%), and drying out in the RW (62%) and FWMC (67%). Table 15 presents the frequency of problems by airframe types.

Only 6 out of 50 pilots said they used re-wetting drops in flight. Five of them used rewetting solution at a rate of two-hourly, and only one TSPT pilot said he used the drops hourly. Eight pilots said they had to remove a CL in flight. Of these, four were operating in the RW, two in the FWSC and one in the FWMC environment. Three had problems removing CL. Four said the CL were uncomfortable, three that they had dried out and one had a particle under a lens. Of 48 pilots reporting, only 2 indicated they had been trained on how to remove a CL in flight. Those who were trained rated the training as "acceptable".

Ninety-four percent (94%) of the pilots wearing CL said they had been trained on how to clean/disinfect their CL. Average rating was acceptable for all professionals except for civilian opticians whose rating was "wholly acceptable". Seventy-two percent (72%) of the pilots wearing a CL in flight said that they always carry a back-up pair of spectacles while 10% said they did not. 60% of these individuals reported wearing strictly CL.

Seventy percent (70%) of pilots said that they did not wear their SCL on an extended-wear basis i.e. more than 24 hours. Of those wearing them on extended basis 53% were TH pilots. Ninety-four percent (94%) of those wearing SCL on extended basis were aware that extended wear was undesirable. 31% of the pilots said that there would be missions in which extended wear would be beneficial. These missions included stand by and quick reaction deployment, transoceanic flights, AWAC's, field and NBCW operations.

Sixty-four percent (64%) of pilots indicated they did not have two pairs of SCL and two packs of disposable SCL and a 30-day current supply of solution at hand for last minute deployment. 59% of the pilots paid for their own CL and related supplies.

Comments/Discusion: Contact lenses provide significant advantages over spectacles in many ways, including superior field of view and compatibility with other equipment. Overall, pilots indicated a high level of acceptability with contact lenses use during flying duties. Generally, pilots appeared to be receiving appropriate training, and to be using their CL correctly.

However, the survey also revealed some surprising findings amongst pilot CL wearers, including loss of lens during flight, significant problems (up to 50%) with dryness, (especially on extended flights) and dust under lenses (especially in RW ops). Few pilots appear to be using rewetting drops, and many do not appear to have the recommended spare lenses and supplies available for deployment. Carrying a spare pair of spectacles during flight is not a universal practice, and some pilot CL wearers do not even own a pair of spectacles. CL are thought to be stable under +Gz based on centrifuge study evaluations, and the reports of CL shifting under +Gz, although rare, is of some concern.

Many of these issues can be addressed by improving training and discussion of CL use with aircrew during aircrew medicals and aircrew eye examinations. However, the results of the Survey suggest that CL are not a panacea for visual correction, and highlights the requirement for ongoing assessment of new medical techniques (such as laser eye surgery) as potentially better solutions for the problem of refractive correction for aircrew.

d. Pilot opinions about using visual aids including laser refractive surgery to optimize normal vision

(1) Corrective lenses

Of those pilots not currently requiring corrective lenses (V1 pilots), 46% indicated they would be prepared to wear a visual correction to increase their VA to better than 20/20. FGT were most and TH least interested in this suggestion. However, there was no statistical differences between operational roles nor was there any differences associated with age group, or position.

Comments/Discussion: Research has demonstrated that correcting small refractive errors to improve uncorrected VA to better than 20/20 can improve visual function especially for small low contrast targets (Rabin J, 1996), and some pilots prefer to have their VA corrected to 20/15 from 20/20 (although still V1). While there is some support for doing so, this requirement should be carefully balanced against logistic and administrative considerations.

(2) Surgical procedures

Twenty-eight percent (28%) of pilots surveyed indicated they would consider undergoing corrective surgery to improve their VA to better than 20/20. Pilots requiring corrective lenses were more likely than normal sighted pilots to favour this method (49% vs 19%; Fisher exact p-value <0.0001). Near sighted pilots (34%) were more likely to consider surgery than far sighted (25%). However, when the possibility of adverse outcomes from eye surgery were included, the percentage of corrected individuals considering surgery decreased to 11% (for a potential increase in susceptibility to glare) and to 8% (for a potential decrease in contrast sensitivity). When an unforeseen potential decrease of VA was included as a possibility, the percentage of those still interested by such surgery decreased to 6%. The likelihood of electing such surgery was significantly higher for corrected than uncorrected individuals (Fisher exact p-value <0.0001) despite potential adverse effects on contrast or glare sensitivity. However, when visual acuity was included as a concern, both populations were equally likely to reject surgery.

14% of the pilots who responded indicated they had considered Photorefractive Keractectomy (PRK) to improve their visual acuity. The response was higher in pilots requiring visual correction than normal sighted pilots (26% vs 4%). Consideration of PRK was not related to being near or far sighted, nor to operational flying roles.

Comments/Discussion : With the increasing advertising of and public awareness of laser eye procedures (PRK and LASIK), it is not surprising that 28% of the pilots polled indicated an interest in a surgical procedure to increase their VA. What is not mentioned in the commercial propagation of these procedures is the potential for complications that may result in unacceptable visual function in the aviation environment (Ivan et al, 1996). Problems may include glare, haloes, haze, starbursts, and blurring in dim lighting and night operations, and decreased contrast sensitivity (Seiler, 1993). Although corneas can be considered as clear due to the lack of symptoms reported by the individuals, tests have revealed that up to 89% of these corneas showed visible and objective sign of corneal haze (McDonald et al. 1991). Visual acuity may be unstable for months afterwards, and in a small percentage, best-corrected visual acuity after such procedures may be worse, and fall below required standards. Laser eye procedures are currently disqualifying for both pilot selection and retention in the Canadian Forces. Candidates are screened with corneal topography at DCIEM to detect laser eye procedures. Medical personnel providing ophthalmologic services for pilots must be aware of both the potential aeromedical compromise of vision after such procedures, and the current CF policy.

CONCLUSIONS

This survey has proven useful as an indicator of areas for improvement in the clinical and medical administrative support offered to our pilots as well as the operational problems associated with the prescription of aids to vision. Visual standards must be related to operational vision requirements, and pilots should be part of the process of establishing these standards. Medical personnel require more training in issues related to aircrew vision, both clinical and operational, in order to provide optimal service to our aircrew clients.

RECOMMENDATIONS

A. VISUAL STANDARD AND CLINICAL SUPPORT

- Medical personnel involved in the provision of vision-related services to pilots should receive more training and information on the specifics of visual requirements, including standards, appropriate

prescription and use of visual aids in the operational environment specific to the individual pilot, interface with other equipment, and related perceptual problems.

- Information on current research and initiatives such as revision of visual standards, laser eye surgery and the importance in air ops of visual functions other than high contrast Snellen acuity should be provided to both the pilot and aviation medical providers through articles in Flight Comment, Flight Surgeons Guidelines, lectures and/or conferences such as the yearly Surgeon General/OpMed conference.

- Both the aviation medical and pilot communities should be involved in the development of vision standards for pilot selection and retention.

- Compatibility of smoke goggle colour filters with CRT colour-coded information should be ensured for all CF aircraft whose instrumentation involves colour coded information using blue and blue-green, yellow or orange coding.

B. SPECTACLES AND CONTACT LENSES

- Personnel who manufacture or prescribe corrective spectacles for pilots should be provided with specific guidelines regarding tinting, distortion limits and anti-ballistic requirement for aircrew spectacles.

- Tables of measurements including distances for the various consoles and print size for each cockpit in the CF inventory, similar to that presented in appendix B1, should be made available to optometrists who manufacture multifocal lenses.

- Medical personnel involved in the prescription of spectacles should be familiar with the cockpit environment of the pilot to whom spectacles are prescribed and follow the recommendation provided at appendix B2 for the prescription and fitting of pilot spectacles especially in the case of multifocals.

- The policy regarding the eligibility for subsidies to contact lenses wearers should be reviewed.

REFERENCES

Asmus TL; Holnagel L and Yolton RL. 1997. Meeting the vision care needs of aircraft pilots. J. Am. Optom. Assoc. 68 (2): 116-124.

Bachman W.G. 1988. Extended-wear soft and rigid contact lenses: Operational evaluation among Army Aviators. USAARL Report No. 88-17.

Backman, HA and Smith FD. 1975. The design and prescription of multifocal lenses for civil pilots. Am J Optom and Physiol Optics. 52 (9): 5915.

Brennan, DH and Girvin, JK. 1985. The flight acceptability of soft contact lenses: An environmental trial. Av Space Environ Med. 57 (1): 43-48.

Dennis, RJ; Hill JR and Ketchum NS. 1991. The durability of hydrogel extended-wear contact lenses worn for daily wear by USAF aircew members. Av Space Environ Med. 62 (6): 565-568.

Dennis, R.J; Apsey, DA; Ivan DJ. 1993. Aircrew soft contact lens wear: A survey of USAF Eyecare Professionals. Av Space Environ Med. 64 (11): 1044-1047.

Epstein D; Tengroth B; Fagerholm, P; Hamberg-Nystrom H. 1993. Excimer PRK for myopia. Letter. Ophthalmology. 100: 1605-1606.

Gartry D; Muir K; and Marshall J. Excimer laser photorefractive keractectomy: 18 months follow up. Ophthalmology. 99: 1209-1219.

Heikens, M-F. 1997. Visual Aids. Lecture presented at the 1997 CF Flight Surgeon Course; 21 Feb 1997, Defence and Civil Institute of Environmental medicine, Toronto. Ontario, Canada.

Heikens, M-F, O'Neill HJ, Gray GW and Salisbury, DS. 1999. 1997 CF Pilot Operational Vision Survey Part I: Operational Visual Requirements. DCIEM Report No.1999-019.

Ivan DJ; Tredici, TJ; Perez-Becerra, Dennis R; Burroughs, JR and Taboada J. 1996. Photorefractive Keractectomy (PRK) in the military Aviator: An aeromedical perspective. Aviat. Space Environ. Med. 67 (8):770-776.

Kuyk, TK. And Thomas, SR. 1990. Effect of short wavelength absorbing filters on the Farnsworth-Munsell 100 hue test and hue identification task performance. Am. J. Opt. Physiol. Opt. 67: 522-531.

Marsh, JS; Cushman WB and Temme LA. 1992. Toward the ideal military aviation sunglass. Naval Aerospace Medical Research Laboratory. NAMRL-1365.

Mcdonald M; Lin J; Byrd, T et al. 1991. Central photorefractive keratectomy for myopia. Ophthalmology. 98: 1327-1337.

Miller RE; Kent JF and Green RP. 1989. Prescribing spectacles for aviators. USAFSAM-SR-89-5.

Morse SE and Reese MA. 1997. The use of bifocal soft contact lenses in the Fort Rucker Aviation Environment. USAARL Report No. 97-27.

Rabin J. 1996. Correction of subtle refractive error in aviation. Aviat Space Environ Med. 67 (2):161-164.

Seiler, T. 1993. Photorefractive keractectomy. Ophthalmol Cli N Am. 6(3):

Schrimsher RH; Lattimore MR. 1991. Prelevance of spectacle wear among US Army aviators. Opt and Vis Sci . 68(7):542-545.

Thomas, SR and Kuyk, TK. 1988. D-15 performance with short wavelength absorbing filters in normals. Am. J. Opt. Physiol. Opt. 65: 697-702.

Young, PA; Ivan DJ; Perez-Becerra, JL. 1999. Aircrew visors and colour vision performance: A comparative (pilot study) analysis. Poster (#261) presented at the Aerospace Medical Association Conference, May 99 Detroit Il.

Table 1 RESPONSES TO, "SHOULD THE CF SELECT ONLY AIRCREW CANDIDATES WITH 20/20 VISUAL ACUITY OR BETTER?"

	Overall pilots (%)	Not corrected (%)	Corrected (%)
Yes	48	50	38
No	52	50	62

Table 2 RESPONSES TO, "ALL THINGS BEING EQUAL, WHICH OF THE FOLLOWING WOULD YOU SELECT AS A PILOT APPLICANT?"

Selection criteria	Overall pilots (%)	Not corrected (%)	Corrected (5)
Uncorrected 20/20 or better	73	77	61
Corrected to 20/20	27	23	29

Table 3 PERCEIVED IMPORTANCE OF NORMAL COLOUR VISION

Rating	Overall pilots	CV1	CV2
Wholly unimportant	3	3	-
Unimportant	10	7	3
Borderline	34	30	3
Important	186	211	5
Wholly important	368	352	-

Table 4 PERCENTAGE OF PILOTS CURRENTLY NOT WEARING ANY SPECTACLES OR CONTACT LENSES INTERESTED IN WEARING CORRECTIVE LENSES TO IMPROVE THEIR VISUAL ACUITY TO BETTER THAN 20/20

Rating	Pilots interested (%)
Tactical helicopter	33
Search & rescue RW	41
Maritime Patrol RW	45
Maritime Patrol FW	48
Transport	47
Fighter	56
Jet Trainer	41
Primary Trainer RW	36

Table 5 PILOT OPINION AS TO WHO SHOULD SET VISION STANDARDS

	Overall pilots (%)	Staff Officers (%)	Operational pilots (%)
Joint group of medical and aircrew	87	87	85
Medical officers only	2	3	0
Operators (pilots) only	11	10	15

Table 6 DISTRIBUTION OF MEDICAL PERSONNEL PERFORMING THE MOST RECENT VISUAL EXAMINATION

Personnel	Frequency (%)
Don't know	3
Flight Surgeon	4
Medical Assistant	24
Ophthalmologic technician (military)	28
Ophthalmologic technician (civilian)	4
Ophthalmologist (military)	7
Ophthalmologist (civilian)	23
Optometrist (civilian)	8
Civilian or Military	
Don't know	3
Military	63
Civilian	35
Generalists or Specialists	
Don't know	3
Generalists*	28
Specialists**	70

* Generalists: Flight Surgeons and Medical assistants

** Specialists: Ophthalmologic technician (civilian or military), ophthalmologists (civilian and military) and opticians

Table 7 PILOT RATINGS OF VARIOUS EYE EXAMINER'S UNDERSTANDING OF THEIR SPECIFIC VISUAL NEEDS

Professional	Rating
Overall	Borderline
Flight Surgeon	Acceptable
Medical Assistant	Borderline
Ophthalmologic technician (military)	Borderline
Ophthalmologic technician (civilian)	Borderline
Ophthalmologist (military)	Borderline
Ophthalmologist (civilian)	Acceptable
Optometrist (civilian)	Acceptable

Table 8 DISTRIBUTION OF SPECTACLE AND CONTACT LENS WEARERS BY AGE, OPERATIONAL ROLE AND AIRFRAME TYPE

Age group (yrs)	Survey overall population (%)	Spectacles only (%)	Spectacles & contact lenses (%)	Contact lenses only (%)
Overall	**30**	**79**	**8**	**13**
20-29	20	86	6	14
30-39	45	72	12	16
40-49	27	81	6	13
50-55	8	95	5	0
Airframe type (Fisher exact p-value 0.017)				
Rotary Wing (RW)	39	76	6	18
Fixed Wing (FW) single crew	30	68	13	19
Fixed wing (FW) multiple crew	31	90	5	5
Operational Role				
Tactical Helicopter	24	73	5	22
Search & Rescue RW	4	90	0	10
Maritime Patrol RW	11	78	9	13
Maritime Patrol FW	10	90	5	5
Transport	20	90	5	5
Fighter	21	71	15	15
Jet Trainer	7	50	8	42
Primary Trainer FW*	0.1	0	0	0
Primary Trainer RW	2	83	17	0

* Only one individual in this operational role answered the survey

Table 9 TYPES OF SPECTACLES WORN AND CHARACTERISTICS

		Frequency (%)	
Percent of population using spectacles:		**29**	
For:	Near	55	
	Far	19	
	Both	26	
Overall corrected population wearing multifocals		**6**	
Type:	Bifocals	90	
	Trifocals	10	
Multifocals prescribed for cockpit			
	Never	44	
	Sometimes	8	
	Always	26	
	Don't know	22	
Multifocals with large enough uninterrupted FOV			
	Yes	70	
	No	30	
Multifocals used		Bifocals	Trifocals
	Progressive	52	13
	Straight top	22	13
	Executive	27	75
Multifocals prefered			
	Progressive	54	
	Straight top	22	
	Executive	24	

Table 10 PROBLEMS ENCOUNTERED WITH SPECTACLES AND ACTION TAKEN

Problems encountered	Frequency counts (%)
Problems	
Image distortion	64
False distance perception	46
Headaches	44
False colour perception	9
Course of action	
Request new pair	42
Went back to old pair	21
Kept on wearing it	12

Table 11 TIMING AND REASONS FOR CHANGING SPECTACLES.

	Frequency counts (%)
Rate for changing spectacles	
Every six months or less	8
Every year	12
Every two years	43
More than two years	37
Reasons for changing spectacles	
Lenses scratched	61
Frame broken	30
New prescription	30
Lenses broken	14
Spectacles lost	11
Like to change at regular intervals	5

Table 12 RANKING PROBLEMS WITH SPECTACLES

a. Fixed wing multiple crew

Problem	Average rating	Friedman ranking	p-value
Pressure points around ears	Important	5	0.0002
Reflection and glare problems	Important	5	
Hot spot around ears	Important	4	
Hot spot around nose	Important	4	
Fogging of lenses	Important	4	
Interference with peripheral vision	Important	4	
Allergenicity to the frames	Borderline	3	

b. Fixed wing single crew N=86

Problem	Average rating	Friedman ranking	p-value
Hot spot around nose	Important	6	<0.0001
Hot spot around ears	Important	5	
Pressure points around ears	Important	5	
Reflection and glare problems	Important	5	
Interference with peripheral vision	Important	5	
Compatibility with O2 mask	Important	5	
Slipping under G	Important	5	
Allergenicity to the frames	Important	5	
Fogging of lenses	Important	4	

c. Rotary wing single crew N=43

Problem	Average rating	Friedman ranking	p-value
Pressure points around ears	Important	7	<0.0001
Reflection and glare problems	Important	7	
Hot spot around ears	Important	6	
Fogging of lenses	Important	6	
Hot spot around nose	Important	5	
Interference with peripheral vision	Important	5	
Compatibility with visor	Important	5	
Compatibility wth NBCD mask	Important	5	
Compatibility with NVG	Borderline	5	
Allergenicity to the frames	Borderline	4	

TABLE 13 **TYPES OF CONTACT LENSES WORN BY CF PILOTS**

	FREQUENCY (%)
Pilots wearing contact lenses	**6**
DISTRIBUTION BY TYPE	
Rigid	6
Semi-rigid	2
Soft	76
Disposable	16
TORIC VS SPHERIC	
Spheric	59
Toric	18
Spheric and toric	4
Don't know	20

Table 14 **REASONS FOR WEARING CL'S AND FRIEDMAN RANKING OF CONTACT LENSES**

	Average rating	Friedman ranking	p-value
Compatibility with life support equipment	5	4	0.6
Peripheral vision	5	4	
Self- esteem	4	4	
Visual acuity	4	3	
Glare	4	3	
Stability under G	4	3	

Table 15

PROBLEMS ENCOUNTERED IN FLIGHT WITH CONTACT LENSES IN ROTARY WING (RW), FIXED WING MULTICREW (FWMC) AND FIXED WING SINGLE CREW (FWSC) ENVIRONMENTS

Problems	**Frequency counts (%)**			
	Overall	**RW**	**FWMC**	**FWSC**
Drying out	52	62	67	47
Dust and/or lashes under the lens	33	43	17	33
Sliding off pupils	26	5	-	33
Popping out	7	33	17	25

Appendix A1 Comments regarding yearly visual examination by an ophthalmologist to determine eye and vision problems.

Time and age

Every 2 years for all ▪ Every two years is enough (43) ▪ Make part of medical so it is done automatically every 2 years instead of current every 5 years (2)	45
Every 2 years after 35 years old ▪ Too often, ▪ Time consuming, already too many medical exams; ▪ Too often for ages 20 to 40. ▪ Beneficial after age 40	24
Every 4 years for all ▪ Every 4 years is good ▪ My vision has been stable for 4 years or more ▪ Excessive, once per operational tour should be adequate for healthy aircrew ▪ Once every five years has been adequate ▪ Every several years would be reasonable	24
Between 2-5 years ▪ Full eye exam should be conducted every 3 to 5 years. ▪ Every three years is enough, If vision was to deteriorate more rapidly the pilot would himself request an eye exam (2) ▪ 2-5 years unless vision has changed - that is reason for only hiring 20/20 people, some will end up needing glasses but almost no chance of vision becoming so bad that they could not fly ▪ 5 years until age 35 then every 2 years	8

Test rational

Current system adequate, pilots would consult quickly if problems araised ▪ The present system is good, no evidence exists to suggest that current procedure is inadequate; ▪ Not needed unless problems arise or are discovered during yearly medical. ▪ Problems with eyes seem to be slow not instantaneous and the exam would simply be of little use in the short term; ▪ Vision does not change significantly from year to year, eyes don't deteriorate quickly enough to require annual exam; ▪ Most people most of the time do not experience major vision changes that would require an annual ophthalmology exam. ▪ Pilot population is by and large young and healthy and routine exams done yearly will screen most problems; ▪ Waste of time for younger people, maybe at a certain age or vision level but not across the board; ▪ I trust the basic yearly exam to detect all but the most rare problems, ▪ Yearly eye chart test is good enough . ▪ When the individual pilot thinks his vision is causing problems; ▪ Problems should be handled on a case by case basis with more regular exams for those with corrected or deteriorating vision. ▪ What's the benefit? Vision categories are already confirmed with basic annual eye test. I don't know if other aspects of vision change substantially with age; ▪ If there are no symptoms present then it is unlikely that any changes requiring an ophthalmologist's attention will have occurred. ▪ For those individuals that do not wear glasses yes, they may be surprised how much a very light prescription might improve their night vision.	117

Appendix A1 (continued)

Test rational (continue)

Cost vs benefits ▪ Unnecessary expense cost vs. benefit, ▪ Seems excessive, ▪ As long as recruiting system attracts sufficient number of people with 20/20 vision to fill requirement there should be no need to compromise; arbitrarily eliminate potential candidates based on visual acuity; start with an excellent product and verify periodically not annually. Divert the cost of annual exam to quality sunglasses with UV protection.	36
Is cyclo exam really necessary ▪ Annual detailed testing is not desirable (cyclo not a pleasant experience); ▪ Cyclo refraction testing is objectionable, necessitates time off work for operational pilot; ▪ I do not object to yearly testing however, the drops used to dilate eyes is uncomfortable and is an unnecessary risk; one eye exam per year? ▪ Sure. Complete exam (cyclo, etc.) not necessary. ▪ Is there a chance of damaging your eyes during these procedures?	7
Current testing not adequate ▪ The present eye test (annual) is a joke. We spend all kinds of time on urinating in a bottle but virtually none on the two most important items in the cockpit - eyes; ▪ normal check for 20/20 will miss near/far sightedness. ▪ I think problems we experience as aircrew have little to do with visual acuity, approx. 15% accidents are mechanical and 85% happen at night - not because pilot has bad eyes but because he can't see due to lack of visual perception ▪ Depends on flight conditions - high NVG and high laser-risk operators should get yearly exams, others As required or requested.	5

Visual category

Only if VA is less than 20/20 ▪ For those with less than 20/20 vision. ▪ Current system plus specialist exam once visual acuity falls below 'X'; at discretion of ophthalmologist	11

Fear

▪ Dangers of loss of medical category by simple error, proof in previous cases; ▪ OK as long as if spectacles are prescribed, career is not shut down; ▪ possible loss of category if more frequently examined and due to higher standard of inspection by an ophthalmologist. ▪ Too many doctors is bad for aviation. Ends up with a lot of emphasis on theory and no common sense.	7

Appendix A2 **Comments provided regarding the reluctance to talk about vision problems with a flight surgeon or an ophthalmologist**

Fear related

99

- It is widely felt that CF is quicker to ground pilots than correct vision problems, you might get grounded, immediate grounding;
- Flight surgeon over-reacts, they don't understand what is required and what is not and are too quick to jump the gun;
- You always wonder when old age will creep up and deteriorate your eyesight;
- I'm tired of the 'old school' politics and pre-conceived ideas towards pilot's with glasses, we are looked down on when all that is needed is the understanding that a normal occurrence has happened, our vision has gone down with age and we simply need a pair of glasses
- Medical category downgraded, loss of category;
- IF I were a borderline visual category;
- Don't want to wear glasses;
- Fear of losing medical category at each medical or ophthalmologist visit;
- Could cost you your job –
- Should be obvious if you love flying,
- Flight surgeon is not your friend; career implications;
- Could be different if CMRB was to be considered ;
- So old that career impact not a factor went V3 on CF-18s;

Mistrust

17

- Anytime you bare your soul to a flight surgeon you also expose your back,
- Mistrust medical system; in an AF where everyone is seeking to limit liability, giving any additional information will get you grounded;
- After 7 years of 20/20 vision, 10 people on squadron suddenly had previously undetected astigmatisms - go figure;
- No trust in CF military doctors to look after patients interest;
- Too little 'discussion' is ever 'off the record' or 'for background';
- No win situation in that you will never come out better than going in;
- If I had a problem I would go to a private doctor first; with the exception of civilian professionals I find military medical personnel myopic (pardon the pun) when it comes to these issues;
- In one instance the doctor involved had no sympathy for my situation and treated my concerns very lightly;
- On my last eye exam I had numerous questions and none of them got answered;
- I do discuss all problems but am sometimes reluctant as I've seen other personnel be unnecessarily screwed by the system;
- Flight surgeons too isolated since hospitals are very undermanned, this applied to all medical issues;
- Civilian ophthalmologists have no idea of CF pilot requirements or career implications caused by reports;
- Most doctors do not understand the effects of glare, reflection or fatigue caused by typical glasses used in cockpits;

Appendix A2 (continued)

Wrong decision made

▪ Ophthalmologist is great, have received wrong information from flight surgeons- he thought I had vision blanks while ophthalmologist (civilian) stated no blanks and wider range than normal; ▪ civilian optometrist recommended correction; military ophthalmologist said "not required"; ▪ The flight surgeon did not understand the rules and had to change his recommendation 2 days later after I showed him the regulation.; - ▪ the flight surgeon wanted to restricted me from flying after having received wrong information from the nurse who filled section II; after discussion with the flight surgeon I got my restriction lifted.	4

Appendix A3 Comments provided regarding the reasons for groundings related to visual problems.

Eye disease or injury

▪ Eye injury; contusion; ▪ Eyelid surgery; ▪ Scratched cornea, ▪ FOD in eye, required patch while cornea healed ▪ Eye infection, ▪ Conjunctivitis; ▪ Viral infection in one eye causing near blindness (temporary) ▪ Iritis; ▪ Inflamed tear duct ▪ Cataracts	25

Spectacles related

▪ Bad prescription given by ophthalmologist followed by two incorrect prescriptions put in lenses by Vanier optical (18 months) situation was unacceptable; ▪ Awaiting arrival of corrective lens; ▪ Temporary grounding due to transition in visual category during training; when it was determined early in my flying career that I needed glasses to fly; ▪ Vision went below 20/20, issued glasses and reinstated; ▪ Awaiting arrival of corrective lens; I put my problem in writing - trying to focus on 3 planes in marginal conditions, the best I could get were tri-focals which have proved useless, after 9000 hrs flying I should know what I need	5

Operational hazards

▪ Snow blindness (temporary) after flying helicopters in very bright snow conditions; ▪ Eye strain due to prolonged requirement to look in direction of sun during landing safety officer duty onboard ship; ▪ Focus problem, low light sensitivity at night, exam showed "central serous retinopathy" not operationaly limiting; ▪ Laser eye injury April 97	4

Visual problems subsequent to other medical problems

▪ Suffered visual problems from migraine, problem has since disappeared following dental surgery to correct bite; ▪ Pink eye, sinus infection cause temporary paralysis	2

Visual problems wrongly diagnosed

▪ Central serous retinopathy – misdiagnosed; checked below 20/20 on eye exam (after flying until 4:00am) - subsequent checks OK; ▪ Flight surgeon thought I had vision blanks	3

Appendix B1

Measurement of distance of instrument panels and consoles and print size of instrumentation for the CH-130 Hercules (Miller et al. 1989)

Pilot and co-pilot console positions	Distance (inches)	Print Size
Approach plates	20	20/30-20/40
Instrument panel	28	20/60-20/70
Center panel	32	20/40
Forward center console	35	20/60-20/70
AFT center console	32	20/50-2070
Overhead panel	18-21	20/60
Pilot's left panel	31	20/30-20/60
Co-pilot's right panel	31	20/30-20/60SPEC

Appendix B2 **Recommendations to civilian and medical personnel involved in the prescription of single or multifocals spectacles for aircrew**

- Personnel should request pilots to always carry with them their helmet, mask and related facial life support equipment when going for the fitting of their spectacles
- Personnel should consider the particular cockpit environment and the unique needs of each pilot.
- Personnel should be aware that for pilots flying more than one type of aircraft especially those of the reserve force component, a different type of bifocals may be required for each cockpit environment.
- Personnel prescribing multifocals should be taken into consideration: aircraft type, seat height adjustment, seat inclination (in the case of CF-18), size of print on instrument panel, working distance for instrument panel and charts, ability to perform near point cockpit tasks at night
- Pilots requiring bifocal should first be fitted with a pair of plano shere lenses to be used as a template for marking, with a black marker, the proper operational bifocal height. This would be done inside the cockpit once the pilot wearing his helmet and mask, if required, has adjusted the seat to its normal flying position.
- Type of multifocals proposed should correspond to the cockpit environment:
  - Executive lenses should be preferred when a pilot has to monitor a wide instrument arrays such as in the case of transport or fixed wing maritime patrol pilot ,
  - Straight top lenses should be prefered when distand peripheral vision is necessary such as in the case of fighter, Tactical helicopter, Search and Rescue rotary wing and Maritime Patrol rotary wing.
  - Double D segment lenses should be made available to pilots who have to read over head panel instruments.
- Advantages and limitations of each type of lenses should be reviewed with all pilots requiring multifocal lenses.
- Multifocals prescription should be evaluated under both normal and dim illumination.
- Pilots should be made awarded of possible problems associated with the wear of new pair of spectacles especially in the case of a significant change in prescription or the new use of bifocal lenses.
- First time bifocal wearers should practice scanning techniques and head movement while wearing the spectacles in a parked aircraft or in the simulator to properly use the bifocal portion of their spectacles.

SECURITY CLASSIFICATION OF FORM
(highest classification of Title, Abstract, Keywords)

DOCUMENT CONTROL DATA
(Security classification of title, body of abstract and indexing annotation must be entered when the overall document is classified)

1. ORIGINATOR (the name and address of the organization preparing the document. Organizations for whom the document was prepared, e.g. Establishment sponsoring a contractor's report, or tasking agency, are entered in section 8)

DCIEM MEDICAL ASSESSMENT AND TRAINING

2. SECURITY CLASSIFICATION (overall security classification of the document, including special warning terms if applicable)

UNCLAS

3. TITLE (the complete document title as indicated on the title page. Its classification should be indicated by the appropriate abbreviation (S, C or U) in parentheses after the title)

1997 CANADIAN FORCES AIR OPERATIONS VISION SURVEY SECTIONS VIII, IX, X AND XI: MEDICAL SUPPORT ISSUES

4. AUTHORS (Last name, first name, middle initial)

HEIKENS MF, O'NEILL HJ, GRAY GW, SALISBURY DA

5. DATE OF PUBLICATION (month and year of publication of document)	6a. NO. OF PAGES (total containing information. Include Annexes, Appendices, etc)	6b. NO. OF REFS (total cited in document)
AUGUST 1999	29	21

7. DESCRIPTIVE NOTES (the category of the document e.g. technical report, technical note or memorandum. If appropriate, enter the type of report, e.g. interim, progress, summary, annual or final. Give the inclusive dates when a specific reporting period is covered)

TECHNICAL REPORT

8. SPONSORING ACTIVITY (the name of the department project office or laboratory sponsoring the research and development. Include the address.)

DCIEM MEDICAL ASSESSMENT SECTION

9a. PROJECT OR GRANT NO. (if appropriate, the applicable research and development project or grant number (please specify which) under which the document was written.	9b. CONTRACT NO. (if appropriate, the applicable number under which the document was written)

10a. ORIGINATOR'S DOCUMENT NUMBER (the official, unique, document number by which the document is identified by the originating activity)	10b. OTHER DOCUMENT NOS. (any other numbers which may be assigned to this document either by the originator or by the sponsor)
DCIEM TR 1999-080	

11. DOCUMENT AVAILABILITY (any limitations on further dissemination of the document, other than those imposed by security classification)

(X) Unlimited distribution
( ) Distribution limited to defence departments and defence contractors; further distribution only as approved
( ) Distribution limited to defence departments and Canadian defence contractors; further distribution only as approved
( ) Distribution limited to government departments and agencies; further distribution only as approved
( ) Distribution limited to defence departments; further distribution only as approved
( ) Other (please specify):

12. DOCUMENT ANNOUNCEMENT (any limitation to the bibliographic announcement of this document. This will normally correspond to the Document Availability (11). However, where further distribution (beyond the audience specified in 11) is possible, a wider announcement audience may be selected.)

13. ABSTRACT (a brief and factual summary of the document. It may also appear elsewhere in the body of the document itself. It is highly desirable that the abstract of classified documents be unclassified. Each paragraph of the abstract shall begin with an indication of the security classification of the information in the paragraph (unless the document itself is unclassified), represented as (S), (C), or (U). It is not necessary to include here abstracts in both official languages unless the text is bilingual).

Introduction: In 1997, DCIEM conducted an Operational Vision Survey of current Canadian Forces pilots. This second report deals specifically with the clinical and administrative support offered at the Base/Wing level and the use of spectacles and contact lenses. **Results:** 1551 questionnaires were sent out. 813 questionnaires were completed and 200 returned "undelivered" for a response rate of 61% of those actually received. On the administrative and clinical support questions, the majority of pilots favoured the selection of candidates with uncorrected visual acuity of 20/20 or better and judged colour vision as an important selection criteria. 46% of the pilots indicated interest in improving their visual acuity throughout the use of spectacles and 23% indicated they would consider eye surgery including photorefractive keractectomy (PRK). When pilots were asked to consider potential adverse effects of surgery on visual acuity, contrast and glare sensitivity, the number contemplating surgical correction dropped significantly. 86% were receptive to yearly complete visual examination. Staff officers and operational pilots wearing spectacles were more likely than uncorrected individuals to accept yearly visual testing. On average the clinical support offered at the base level was judged as "acceptable" but the understanding of the specific visual requirements for pilots by the medical professionals was considered as "borderline". Pilots were more likely to discuss openly visual matters with civilian than military professionals and their reluctance level increased when previous grounding had occurred. 29% of the surveyed pilot population were wearing either spectacles and/or contact lenses. 6% of the group requiring visual correction were wearing multifocals but these were seldom correctly prescribed for their current cockpit environment. Tactical and fighter pilots considered that their multifocals did not have large enough unrestricted and uninterrupted field of view. The majority of these pilots also considered double segment multifocals useful but only 10% of them were wearing them . On average the spectacles offered by the CF were judged as "acceptable" and received within one month of their request. 41% of the pilots reported perceptual problems with a new pair of spectacles. The most common problem encountered was one of distortion. 5% of the pilots wearing spectacles reported having been injured by their spectacles mainly along the nasal bridge. Soft contact lenses (SCL) are the preferred contact lenses worn by the CF pilots. The main problems reported with SCLs was drying out and dust/lashes under the lenses. **Conclusions:** Medical personnel should develop a better understanding of operational visual requirements, life support equipment and cockpit configuration to improve their clinical and administrative support to pilots. Personnel working closely with pilots or prescribing visual aids should be provided with up to date information regarding operational visual requirements. They must provide pilots with useful and pertinent information on the potential impact of decreased visual function on their task capabilities.

14. KEYWORDS, DESCRIPTORS or IDENTIFIERS (technically meaningful terms or short phrases that characterize a document and could be helpful in cataloguing the document. They should be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location may also be included. If possible, keywords should be selected from a published thesaurus, e.g. Thesaurus of Engineering and Scientific Terms (TEST) and that thesaurus identified. If it is not possible to select indexing terms which are Unclassified, the classification of each should be indicated as with the title.)

Aircrew, vision, standards, spectacles, contact lenses